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Influence of the geographical scope on the research foci of sustainable forest management: Insights from a content analysis

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ABSTRACT

Individual approaches to sustainable forest management have to be operationalized according to the regionally specific environmental conditions and stakeholder requirements. Unique regional socio-economic conditions also significantly impact stakeholder requirements of globally acting forest sector companies. Therefore, forest-based sector decision makers have to be aware of regionally-specific and context sensitive sustainability concerns, when assessing and prioritizing sustainability issues. Sustainability research is considered to have a regional focus and a problem-driven perspective. Hence, research foci of scientific discussion on sustainable forest management can provide insight into regional differences and problems of sustainable forest management. We conducted a quantitative content analysis of 643 scientific abstracts in the context of sustainable forest management. We observed 16 different topic categories, out of which the topics of forest health and conservation and forest management practices represent the dominant foci. Furthermore, our results confirm a strong impact of geographic scope on the research foci. For example, the issues of climate change mitigation and adaptation are significantly more investigated in the Global North while social impacts of forest management are more researched in the Global South. Our findings suggest that decision makers should consider more than environmental issues when selecting corporate social responsibility activities or when making environmental policies. Otherwise, they can potentially overlook the impacts of forest management which are of high regional importance and intensively investigated by the scientific community.

1. Introduction

Sustainable forest management (SFM) is one of concepts which were significantly influenced by the publication of the Brundtland report (WCED, 1987). Main notions of the report (e.g. intra- and intergenerational equity, solidarity and environmental limits to global development) (Langhelle, 1999) prompted the policy debate on environmental governance to include multiple stakeholders and their diverse interpretations of sustainability (Sneddon et al., 2006). An understanding of the concept of SFM developed in a similar fashion. Although the modern understanding of SFM still retains some conceptual vagueness (Wang, 2004), its two main hallmarks are a theoretical foundation in the concept of sustainable yield management and an inclusion of a wide range of social demands through the adaption of participatory processes (Hahn and Knoke, 2010).

Together with the rise of sustainability discourse, the field of corporate social responsibility (CSR) experienced a powerful resurgence in its activity (Vogel, 2005; Carroll, 1999). At the time, new theoretical contributions of stakeholder theory and business ethics theory sparked an increased interest in CSR (Carroll, 1999). Also, structural changes in the socio-legal and socio-economic framework over the last decades of the 20th century (e.g. globalization, liberalization of trade) were another driver of the increased interest into CSR because they further bolstered the role of large corporations as major social and political actors (Vogel, 2005; Keinert, 2008). At the same time, rising environmental consciousness has sparked an increasing social pressure on companies to take responsibility for the full extent of their impacts on society and environment. Hence, implementation of CSR has become one of the main priorities for business leaders (Porter and Kramer, 2007; Maon et al., 2010).

CSR and the related achievement of a social license to operate are of special importance in forestry and other extractive, resource intensive

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industries, (Moffat et al., 2016). Forest-based sector plays a key role in global sustainable development due to the importance of its raw material base and spread of the production areas into the developing countries (Li and Toppinen, 2010). When operating in emerging economies, the environmental performance of foreign owned companies is especially scrutinized (Kim et al., 2015). Thus, the inclusion of sustainability concerns of a companies' stakeholders into business operations is of high significance in the forest-based sector (Toppinen and Korhonen, 2012; Moffat et al., 2016).

However, the evaluation of what a companies' significant social and environmental sustainability impacts are, is exceedingly complex because it underlies the subjective valuation of different stakeholders. Namely, CSR is conceptualized as a stakeholder-oriented concept (Maon et al., 2010) and thus it is by definition focused on the concerns of a companies´ stakeholder (European Commission, 2001).

In this context, scientists can be considered as one of the stakeholder groups which are essential for the promotion of SFM. Scientists are one of the actors with a high "standing" in the mass media debate on environmental problems, which gives them the ability to frame the public discourse regarding the discussed issues (Kleinschmit and Sjöstedt, 2014). Moreover, scientists also play a prominent role in the forest policy development process (Werland, 2009; Pregernig, 2014). However, it has to be noted that the extent to and conditions under which scientific knowledge impacts political decisions are still debated.[2] Nevertheless, there is a growing understanding that environmental governance has to strongly rely on the scientific expertise (Grundmann, 2009; Pregernig, 2014; Turnhout et al., 2016). Furthermore, scientists play a crucial role in the technology and knowledge transfer collaborations. Such knowledge and technology transition mechanisms have a long tradition and are of high importance for wood industry (Hrovatin et al., 2008; Van Horne et al., 2012). Industry-university collaborations have shown to be highly beneficial for the ecological restoration projects (Jones et al., 2017) and are also considered necessary to achieve sustainability goals (Orecchini et al., 2012).

However, the challenge of providing and proving sustainability claims in the forest-based sector goes beyond acknowledging for, often conflicting, demands from disparate stakeholder groups. An appraisal of sustainability issues in the forest-based sector is additionally exacerbated by the fact that the meaning behind the concepts in forestry is dynamic and depending on the temporal and geographical context (Mårald et al., 2016). Moreover, Panwar and Hansen (2007) conclude that unique, regional, socio-economic structures strongly influence the CSR issues of forest product companies. Hence, when assessing and prioritizing sustainability issues, decision makers of the forest-based sector have to be aware of regional-specific and context sensitive sustainability concerns.

Sustainability focused research is inherently characterized by a problem-driven perspective and a regional focus (Kates, 2011; Miller, 2013). This makes the research foci highly suggestive of the existing local problems and trends. Therefore, by analyzing the geographical context and the emphasis awarded to individual topics of scientific discussion, we can gain additional knowledge on the main regional sustainability issues. Nevertheless, we found no scientific publication which investigated this kind of relationship within the scientific discussion on SFM. In order to shed light on the regional specific issues of SFM and to explore regionally different emphases of scientific discussion on SFM, we conduct a content analysis of 643 abstracts investigating SFM. The aim of the study is to answer the following research questions:

1. What are common research foci in scientific discussion on SFM?
2. How does the geographical scope impact the research foci and the intensity of the scientific discussion on SFM?
3. Do the content and the intensity of the scientific discussion on SFM change over the analyzed time period?

2. Methods

2.1. Content analysis

Content analysis was developed by communication researchers as an empirical research method for the analysis of mass media messages (Schreier, 2012). Over time, content analysis has gained importance in the social sciences and has been widely applied by many disciplines (Krippendorff, 2004). It has also become an increasingly important tool applied by forest policy researchers (Kleinschmit and Sjöstedt, 2014).

There are two distinct methodological approaches to the content analysis: quantitative (Bryman, 2012) and qualitative (Schreier, 2012). The qualitative content analysis is commonly conducted to analyze the public media discourse related to forest policy (Sadath and Rahman, 2014; Riedl et al., 2016) or to review changes and conflicts in policy development processes (Fischer et al., 2016). On the other hand, the quantitative content analysis is often applied to investigate the framing of the forest policy issues in the mass media (Sadath et al., 2013; Kleinschmit and Sjöstedt, 2014) or to investigate corporate communications (Korhonen et al., 2016).

In our study, we applied quantitative content analysis to investigate impact of a geographical and a temporal scope on the issues researched by the scientific community investigating SFM. We employed quantitative content analysis according to Bryman (2012), as an approach to the analysis of documents which quantifies content in terms of predetermined categories in a systematic and replicable manner. The decision to apply the method draws upon its suitability for the research identifying: subjects and themes being discussed, the degree of emphasis awarded do the certain topics and the temporal trends in the discussion (Neuendorf, 2002; Bryman, 2012). Moreover, the quantitative content analysis allows a statistical analysis of the analyzed content and the generalization of the results (Neuendorf, 2002).

2.2. Unit of analysis

In our study, the abstracts of scientific papers published in peer-reviewed journals were considered as the unit of analysis. Based on the guidelines for abstracting, it can be assumed that abstracts include the most relevant aspects of each scientific paper. Compared to the analysis of a whole publication, the analysis of an abstract allows for an accurate identification of the research foci and simultaneously enables the analysis of a larger data sample.

2.3. Data collection

The data collection was performed by conducting a query on Scopus, the largest database for peer-reviewed literature. The query details are presented in Table 1. The final conditions of the query were selected regarding the methodological requirements, results of several test queries and careful discussion of the results with multiple researchers.

The keywords were selected to limit the scope of the study to the abstracts discussing SFM and the related impacts. The query encompassed abstracts published between 2008 and December 2015. As depicted in Table 1, 1834 scientific papers satisfied the query criteria. The keywords were carefully selected and discussed among multiple researchers. However, the initial data sample still included abstracts addressing the topics outside of the scope. For example, global consuming patterns (Koh and Lee, 2012), environmental labeling (Bergman and Taylor, 2011) or development of new indicators for sustainability assessment methods (Garrigues et al., 2012). Therefore, a two-stage

[2] For a recent and a comprehensive review of the theoretical models of scientific knowledge transfer in the science-policy interface please see a recent review by Böcher and Krott (2016).

Table 1
Details of the database query on Scopus.

Aspect	Specification/result
Date of query:	02 Dec 2015
Query text:	"Sustainab* forest*" (Art,Tit, Abs, KWs)[a] AND "forest* impact" (Art,Tit, Abs, KWs) OR "plantation impact"
Document type:	Article or Review
Time span:	2008–2015[b]
Further criteria:	Subject area is not "Health Sciences", country/territory is not New Zealand or Australia[c]
Number of results	1834

[a] Art – article, Tit. – title, Abs.- abstract, KWs – keywords.

[b] The year 2008 was selected as a starting point based on the results of the preliminary test queries and the methodological requirements. On the one hand, a shorter time span would result in decrees of a number of observations which would limit the analysis and the interpretation of the results. On the other hand, application of a longer time range would probably not increase the likelihood of generating new results (we reached a data saturation point) and would generate a sample, size of which is not suitable for the traditional quantitative content analysis (Holsti, 1969). Application of algorithmic approaches to content analysis (Schober et al., 2018) is advisable in such a case.

[c] The decision to exclude Australia and New Zealand draws upon the results of the preliminary test queries. In all of the tested combinations of query conditions, there were too few observations to conduct a meaningful analysis. Also, all of the observed abstracts addressed highly distinct issues. Therefore, we consider that it would be more in line with a good scientific practice to exclude the given countries from the analysis than to provide rough generalizations based on the highly limited data.

data sampling technique was applied to sample data as objectively as possible and to ensure that the analyzed abstracts are addressing SFM and the related impacts.

Firstly, the sampled abstracts were screened according to their geographical scope. We excluded the abstracts which do not disclose the location to which the study refers because they do not allow for the analysis of the impact of the geographical scope of the research foci (RQ2). We also excluded the multi-continental studies in order to keep the data sample consistent. In the second stage, abstracts were manually screened and those which did not address SFM were excluded. The application of a non-probability sampling for content analysis is warranted when adequate sampling frame is not available (Riffe et al., 2005). In our study, we applied purposive sampling because the application of a randomized sampling would obviously lead to the analysis of an unrepresentative population. In order to avoid bias, the initial selection was critically reviewed by another researcher. The final sample size amounted to 643 abstracts. The list of all the analyzed references is attached as Appendix A.

2.4. Coding manual and coding framework

To satisfy the requirements for the objectivity and the replicability of the analysis (Bryman, 2012; Neuendorf, 2002), a coding manual was developed. The coding manual represents a category system which allows coding of the analyzed material in relation to a research question and provides the coder with the descriptions of all the categories and dimension being coded (Bryman, 2012).

In order to identify the research foci as accurately as possible, we applied an inductive, data-driven approach to the development of the coding manual. Firstly, we conducted a pilot coding on the abstracts published between the 2011 and 2015. We awarded individual codes to each abstract according to the abstract's research foci which we assessed from the abstract's content and the keywords. By the end of the pilot coding, no new codes were emerging, which suggests that the data saturation point (Tran et al., 2016) was reached. The final list of individual codes was streamlined in order to ensure that there is no conceptual overlap between the codes and that the codes are mutually exclusive.

Secondly, we created topic families by aggregating the individual codes according to their meaning and patterns observed during the coding. We tested different code aggregation options before finalizing the list. The establishment of coding families provides a structure to the data and is a basis for the data analysis. Fig. 1 represents the structural hierarchy of the applied coding framework. We grouped the topic families into the two major superfamilies: environmental and socio-economic topics. This allows comparison between the different sustainability dimensions. It was not possible to develop a clear distinction between the economic and social sustainability issues. Lastly, we structured the topic families into subfamilies in cases when 50% of abstracts which comprise one topic family were thematically highly similar. We created the individual subfamilies due to apparent importance of this topic subfamily. The same approach was applied to aggregate individual codes into the topic families comprising the superfamily "Socio-economic issues". Therefore, only two topic families constitute this superfamily.

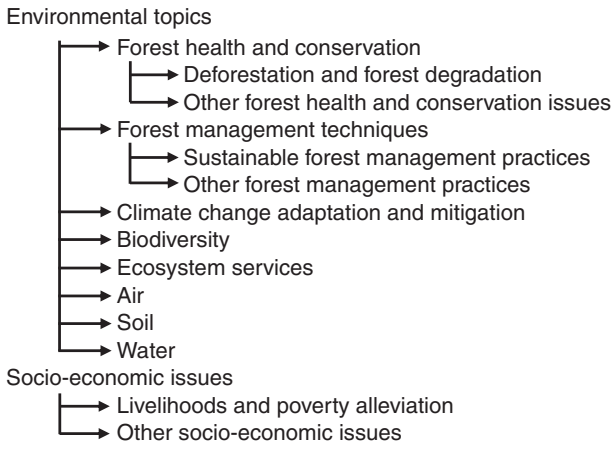

Fig. 1. Hierarchy of the coding categories.

Note that an abstract can comprise multiple individual codes and that therefore multiple coding categories (topic families, subfamilies and superfamilies) may be assigned to a single abstract. The list of all the coding categories with the respective descriptions is attached as Appendix B.

2.5. Coding and the intra coder reliability test

After we developed the coding manual, a single researcher coded the complete data set by using the scientific qualitative data analysis software Atlas.ti (Friese, 2013). The coder coded each abstract according to the three dimensions: the topics (research foci) discussed in an abstract, the geographical scope (continent) of an abstract and the year of publication. Table 2 presents the frequency distribution of the analyzed abstracts per year of publication and the geographical scope of the study.

We performed the control coding in order to check the intra-coder reliability, bias or over-interpretation on the part of the single coder. A second researcher re-coded the set of 20 randomly selected abstracts

Table 2
The frequency distribution of analyzed abstracts per year of publishing and the geographical scope of the study.

Year		2008	2009	2010	2011	2012	2013	2014	2015
Africa	88	5	10	10	18	12	16	13	4
Asia	180	18	17	27	30	32	20	23	13
Europe	146	12	15	17	29	25	16	20	12
North America	140	23	18	16	22	21	18	12	10
South America	89	18	19	8	7	13	8	11	5
Total	643	76	79	78	106	103	78	79	44

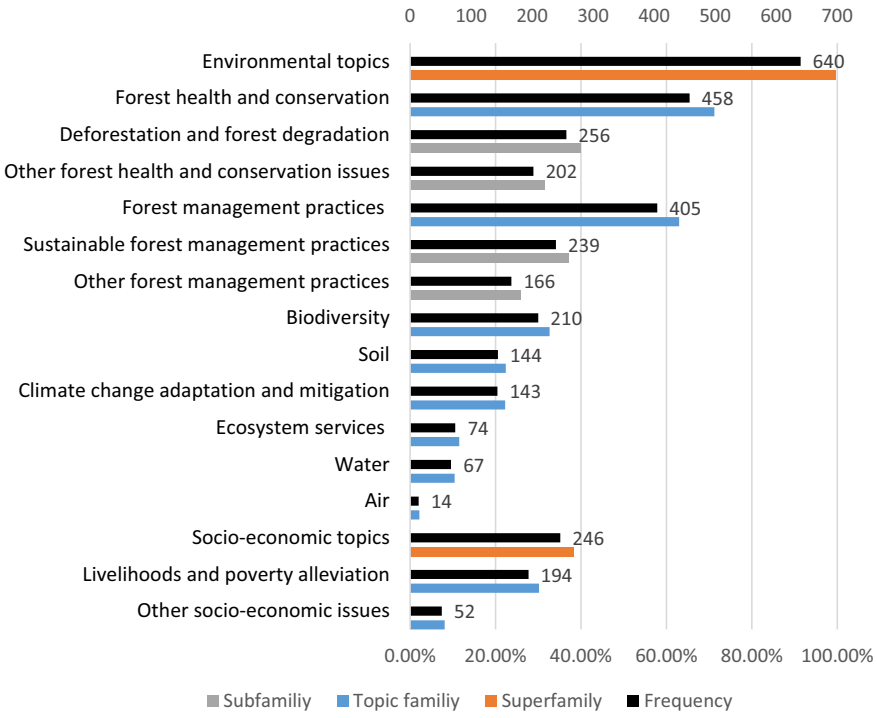

Fig. 2. Absolute and relative frequencies of the coding categories.

and the results were compared. After the first control coding, we had to re-code the coded sample due to identified inconsistencies. We checked the re-coded sample by the same procedure, this time we detected no significant inconsistencies which allows us to conclude that we reached a satisfactory level of coding consistency.

3. Results

3.1. Topic family frequencies

Fig. 2 depicts the absolute and relative frequencies of all the coding categories. The sum of topic family frequencies is higher than the total number of analyzed abstracts because one abstract can discuss multiple topics. The most frequent topic families are “Forest health and conservation” and “Forest management practices” occurring in 458 (71.23%) and 405 (62.99%) analyzed abstracts respectively.

The topic superfamily “Environmental topics” has the highest frequency (640) and occurs in 99.53% of the analyzed abstracts, while the second superfamily “Socio-economic topics” occurs in 246 abstracts (38.26%). Another difference between the superfamilies arises in the number of the subsumed categories. The superfamily “Socio-economic issues” is structured only into 2 topic families. Conversely, the superfamily “Environmental topics” comprises 8 topic families and additional 4 subfamilies.

The topic subfamily “Deforestation and forest degradation”, a subset of the topic family “Forest health and conservation” is one of the most frequently occurring categories. It occurs in 256 (39.81%) abstracts and it represents, 55.90% of all the abstracts belonging to the main topic family. Similarly, the topic subfamily “Sustainable forest management”, a subset of the topic family “Forest management practices”, occurs in 239 (37.17%) analyzed abstracts and it presents 59.01% of the abstracts of the main topic family. Lastly, the topic family “Livelihoods and poverty alleviation”, a subset of the superfamily “Socio-economic topics”, occurs in 194 (30.17%) analyzed abstracts and it simultaneously represents 79.86% of all the belonging to the superfamily “Socio-economic topics”.

The least frequently occurring topic families are the topic families comprising abstracts discussing the impact of forest management on specific environmental media: “Soil” (22.40%), “Water” (10.42%) and “Air” (2.18%) together with the topic families “Ecosystem services” (11.51%) and “Other socio-economic issues” (8.09%).

3.2. Geographic scope

Table 3 presents the p-values of the chi square-test inspecting the significance of the impact of the geographical scope on the topic family frequency distribution. For 9 out of 16 coding categories, the test confirmed significant differences (p-value < 0.05). The test results for the two superfamilies are significantly different. The superfamily “Socio-economic topics” has a p-value of 0.00 while the superfamily “Environmental topics” has a p-value of 0.51.

Fig. 3 depicts the relative deviation between the observed and the expected topic family frequency per continent weighted according to the number of abstracts. The biggest deviation between the observed

Table 3
The p-values of the chi-square test testing the influence of geographical scope on the topic family frequency.

Coding categories	p-value
Livelihoods and poverty alleviation	0.00
Socio-economic topics	0.00
Deforestation and forest degradation	0.00
Other forest health and conservation issues	0.00
Climate change adaptation and mitigation	0.00
Sustainable forest management practices	0.00
Forest management practices	0.00
Other forest management practices	0.00
Forest health and conservation	0.00
Soil	0.06
Biodiversity	0.10
Air	0.11
Other socio-economic issues	0.21
Ecosystem services	0.29
Environmental topics	0.51
Water	0.89

Fig. 3. Relative deviation between the observed and expected topic frequency value per continent weighted according to the number of abstracts per continent.

and expected topic frequency occurs in the case of the topic superfamily "Socio-economic topics", its subset "Livelihood and poverty" and the topic subfamilies: "Deforestation and forest degradation" and "Other forest health and conservation issues". We observed an over-representation of the topic superfamily "Socio-economic topics", its subset "Livelihoods and poverty alleviation" and the subfamily "Deforestation and forest degradation" in case of studies conducted in Africa and Asia. Lastly, the topic family "Climate change adaptation and mitigation" is overrepresented in studies conducted in Europe and North America.

3.3. Temporal trends

Table 4 presents the individual frequencies of coding categories per year. The average number of analyzed abstracts per year is 80.38. The highest number of abstracts per year is 106 (2011) and the lowest is 44 (2015).

The results of the testing confirm significant impact on the frequency distribution over the analyzed time frame only in the case of one topic family: "Climate change adaptation and mitigation" (p-value = 0.01).

4. Discussion

4.1. Research foci of the scientific discussion on SFM

Raising customer awareness towards sustainability and environmental issues is one of the five factors shaping the present and future of the forestry sector (Vihervaara and Kamppinen, 2009). The investigation of research foci within SFM provides insight into main regional sustainability issues because sustainability research is characterized by a regional focus and problem-driven perspective (Kates, 2011; Miller,

Table 4
Frequency of coding categories per year and the p-value of the chi-square test.

Coding categories	2008	2009	2010	2011	2012	2013	2014	2015	p-value
Climate change adaptation and mitigation	12	9	16	19	29	24	19	15	0.01
Other forest health and conservation issues	31	33	24	31	26	24	22	11	0.08
Livelihoods and poverty alleviation	17	26	25	40	34	19	26	7	0.11
Environmental topics	76	79	78	106	103	77	77	44	0.15
Other forest management practices	20	20	16	23	32	25	19	11	0.17
Forest health and conservation	62	59	58	77	70	48	54	30	0.22
Forest management practices	55	48	49	56	66	53	48	30	0.23
Biodiversity	23	26	27	29	31	32	23	19	0.41
Ecosystem services	7	10	9	10	12	5	14	7	0.45
Sustainable forest management practices	35	28	33	33	34	28	29	19	0.46
Soil	16	12	15	24	25	24	18	10	0.51
Deforestation and forest degradation	31	26	34	46	44	24	32	19	0.55
Other socio-economic issues	8	9	4	3	8	6	6	8	0.62
Air	3	2	1	3	0	3	1	1	0.62
Socio-economic topics	25	35	29	43	42	25	32	15	0.72
Water	7	6	6	11	12	10	9	6	0.92
Total	428	428	424	554	568	427	429	252	

2013). We employed quantitative content analysis to: identify main research foci, describe the temporal trends and the impact of the geographical focus on the intensity and the content of the scientific discussion on SFM.

As expected, the superfamily "Environmental topics" occurs in 99.53% of the abstracts. Conversely, 38.26% of the abstracts are assigned to the superfamily "Socio-economic topics". We identified only three abstracts in which the two superfamilies did not co-occur. High co-occurrence confirms that the SFM is practically never discussed in purely socio-economic terms and that it is contextually firmly embedded into the environmental dimension of sustainability. These findings imply that the socio-economic issues of SFM are predominantly discussed through a conceptual framework of socio–ecological systems theory (Rosser, 2013) in which none of the dimensions is approached independently due to complex interactions.

Our results also show that the social sustainability of forest management is one of the dominant research foci in the global discussion on SFM. On the contrary, Barkemeyer et al. (2014) observed that the main, global business-oriented sustainability initiatives (e.g. CERES Principles, OECD Guidelines, UN Global Compact) put a predominant focus on the environmental issues and award comparatively little attention to the social issues. Moreover, we observed the dominance of the topic family "Livelihoods and poverty alleviation" within the superfamily "Socio-economic topics". The given topic family is also strongly overrepresented in Africa and Asia. These findings show that the scientific discussion on social aspects of SFM is based on the problem of poverty and the impact of forest management on the communities directly depending on forests for their livelihoods. Therefore, the scientific discussion on socio-economic issues of SFM still reflects the main notion of the Brundtland report; which emphasizes that the needs of the world's poor have to be prioritized when meeting the needs of the present society (WCED, 1987). On the other hand, Barkemeyer et al. (2014) argue that the emphasis on the world's poor is lost in the main, global corporate sustainability initiatives. Based on our results and the findings of Barkemeyer et al. (2014), we conclude that there is a discrepancy between the multi-faceted approach to sustainability in the scientific discussion on SFM and the Brundtland Report on the one side, and predominantly single dimensional global business-oriented sustainability initiatives on the other side.

Similarly to corporate sustainability initiatives, the concept of green supply chain management advocates sustainability assessment of a company's supply chain based only on environmental criteria (Ahi and Searcy, 2013). However, as shown by our results, the consideration of exclusively environmental sustainability criteria can potentially overlook the impacts of forest management which are of a high regional importance and intensively investigated by the scientific community. Such a failure to address the full spectrum of sustainability criteria can compromise the adherence to the precautionary principle, and thus endanger the overall sustainability of a project (Cooper and Hsiao, 2014).

The topic family "Ecosystem services" is found to be one of the least discussed categories. At the same time, ecosystem services (ESS) have a great importance for society in general (MEA, 2005) and especially for forestry. Forestry, as a resource based and extractive industry, simultaneously relies on a variety of ESS (Patterson and Coelho, 2009) and significantly impacts the future provision of the same services (D'Amato et al., 2015). Moreover, there is a strong need for more empirical research on the relationship between the SFM and ESS in order to enhance existing approaches to SFM. For example, synergies and linkages between the biodiversity of forests and the provision of ESS are not well understood (Mori et al., 2017) and it is unclear which forestry practices have the strongest impact on the provision of ESS (Pohjanmies et al., 2017). Therefore, although there is a strong demand for data within the forest sector, our results suggest that the ecosystem services are nonetheless a minor research focus in the scientific discussion on SFM. Our results could be explained by the existence of a highly similar, competing concept like "forest functions" (Pistorius et al., 2012), especially because the concept of "forest functions" is strongly rooted in forestry (Kindler, 2016). However, this is not the case because the concept of forest functions is widespread only in the German speaking area, applied primarily by practitioners and politicians in management guidelines and policy papers, and it therefore has a "low scientific relevance compared to ESS in forests" (Kindler, 2016).

4.2. Impact of geographical scope on the frequency of coding categories

We observed significant differences in intensity of the discussion between the continents for 9 out of 16 coding categories. The frequency of the superfamily "Environmental topics" was highly insensitive to the geographical scope (p-value = 0.81) while the superfamily "Socio-economic topics" has almost the opposite result (p-value < 0.00). However, these results cannot be generalized because there are significant differences within each superfamily. For example, the frequency of the topic family "Livelihoods and poverty alleviation" was highly sensitive to the geographical scope (p-value < 0.00), while there is no statistically significant impact in the case of the topic family "Other socio-economic issues" (p-value = 0.21). This shows that the individual research foci of the scientific discussion on SFM are sensitive to the unique regional characteristics and they reflect not only environmental but also different socio-economic conditions. In fact, the significant impact of the geographical scope was observed even in the case of the topic family "Climate change adaptation and mitigation" (p-value < 0.00), an issue which is of equal importance worldwide and currently globally prominent. Therefore, although the continents perform quite similar in several coding categories, scientific discussion on SFM has a regional focus which is an important characteristic of sustainability science (Kates, 2011).

The sensitivity of the research foci to the regional conditions revealed different research emphasis between the studies conducted in the Global North and the ones carried out in the Global South. On the one hand, the topic family "Deforestation and forest degradation" is overrepresented in African (14.73%) and Asian (12.41%) studies while being simultaneously underrepresented in the European (−15.16%) and North American studies (−12.67%). Our observations are in line with a recent study (FAO, 2015) confirming that the most of the world's deforestation is taking place in Africa and South America. On the other hand, the topic family "Climate change adaptation and mitigation" was strongly overrepresented in Europe (+12,01%) and simultaneously underrepresented in South America (−12,13%) and Africa (−9.74%).

The biggest differences between the observed and the expected intensity of the discussion in relation to the geographical scope occur in the case of the following topic families: "Land use conversion, destruction and degradation of forests" and 'Livelihoods and poverty alleviation'. Although our results cannot prove the causation or mutual relationship between the issues, the simultaneous overrepresentation of the given topic families at the same continents is suggestive, especially if the results are interpreted through the theoretical framework of the forest transition theory (Mather, 1992) and the related concept of Environmental Kuznets Curve (Grossman and Krueger, 1995). Both concepts elaborate on the inverse parabolic relationship between environmental degradation and economic development. Although the concept of Environmental Kuznets Curve is lately being contested, it is still present in literature as one of the main hypothesis for the explanation of forest transition process (Choumert et al., 2013). In given context, our results support the findings of other authors confirming a strong connection between the forest conservation in Africa and socio-economic and political issues (Mukwada et al., 2013), as well as the high importance of social conditions on mitigation of poverty-related deforestation in Asia (Hübler, 2017).

4.3. Temporal trends in the scientific discussion on SFM

The analysis of temporal trends confirmed a high temporal stability of the scientific discussion on SFM in its content and intensity. As presented in Table 3, we observed a statistically significant impact on the frequency distribution over the analyzed time period only in the case of the topic family: "Climate change adaptation and mitigation".

We observed an upward trend in the number of abstracts coded under the given topic family. This increase in the intensity of the discussion on the role of SFM in the mitigation of climate change may be explained by the globally rising prominence of the climate change debate in the society (Kleinschmit and Sjöstedt, 2014) and the critical role of forest management in the international climate change mitigation policy (IPCC et al., 2014). Lack of statistically significant differences for the remaining 15 coding categories further supports the conclusion that the scientific discussion on SFM is globally highly stable in its intensity and homogenous in its content over time.

Lastly, the number of analyzed abstracts published in 2015 is significantly lower (44) than the observed yearly average (80.38). This result can be explained by the limitations of the data collection method. We collected the data on 2nd December of 2015. At the time, not all of the articles were published or indexed for the year 2015, leading to the lower observation of published articles for the given year. However, the fact that this limitation did not cause false observations of descending trends in frequency distribution of individual coding categories or prevented the observation of the long term ascending trends (as in the case of the topic family "Climate change adaptation and mitigation"), allows for the conclusion that this issue did not have a significant impact on the study results.

5. Conclusions

We employed a quantitative content analysis in order to investigate the temporal trends and the impact of the geographical focus on the intensity and the research foci of the scientific discussion on SFM.

Forest health and conservation and forest management practices represent the dominant research foci of scientific community investigating SFM, both of which have dominant subtopics. Deforestation represents the most researched environmental issue while the development of forest management practices explicitly designed for SFM dominates the research of forest management practices. We also observed differences in the intensity of the discussion over the socio-economic impact of SFM between the Global South and the Global North. The role of SFM in poverty alleviation and in providing subsistence to local communities represents the dominant research focus of scientific discussion on SFM in Africa and Asia. Our results suggest that a consideration of exclusively environmental issues either when selecting CSR activities or when making environmental policies can potentially overlook the impacts of forest management which are of a high regional importance and intensively investigated by the scientific community. Results of the longitudinal temporal analysis suggest that the scientific discussion on SFM is highly stable. Only the discussion regarding the relationship between SFM and the issue of climate change increased significantly in its intensity over time, which is in line with the broader societal trends.

As any scientific work, this study has its own limitations. Firstly, we have collected our data sample from the database Scopus and investigated only the abstracts published in English. Although Scopus is the largest database of peer-reviewed literature, it does not index all the articles which investigate SFM. This is especially relevant for the scientific work which is not published in English. However, although Scopus does not provide an exhaustive list of articles investigating SFM, the size of the database and the fact that it is commonly used as a data source in peer-reviewed literature reviews suggest that it provides an adequate list of relevant scientific literature. Secondly, Scopus shares the same weaknesses with the international scientific publishing. Global scholarly work is characterized by a Global North-South imbalance. Researchers from developing countries are struggling to integrate their scientific publications into the established international channels. Therefore, it can be assumed that our sample reflects primarily the work of researchers affiliated with the institutions based in the Global North. Thirdly, results of scientific studies which are relevant for forest management are often not published in scientific journals, but aimed at practitioners and therefore disseminated via brochures and guidelines. An analysis of this kind of grey literature would further reinforce the results of our study. However, lack of a comprehensive index of both types of literature obstructs systematic and scientifically robust analysis.

An another potential limitation of this study concerns the selection of the analyzed abstracts. Firstly, we have excluded the abstracts which do not explicitly disclose the geographical scope of the study. The inclusion of such abstracts could impact the observed intensity of the scientific discussion over the specific issues. However, such abstracts do not allow for the observation of a geographical scope and are therefore unsuitable for the analysis according to the stated research questions. Secondly, the terms chosen for the query as well as the delimitation of what abstracts are considered relevant are subjective and might distort the results to a limited degree. Thorough attention has been paid to sample the analyzed abstracts as objectively as possible. Nevertheless, sampling performed by another group of researchers would probably yield a sample comprising somewhat different abstracts. However, the impact on the results and the reproduction of the study is limited because the abstracts were delimitated through careful discussion with other researchers and several different options for aggregation of individual codes into topic families were tested.

Lastly, since sustainability is a highly normative concept, investigation of the role of cultural differences in conceptualization of SFM by the scientific communities of different geographical regions, arises as an interesting line of scientific inquiry. This could be theoretically achieved by considering the affiliations of researchers. Such an approach was tested in a pre-study conducted by the authors prior to the analysis presented in this paper. However, the results of such an analysis were lacking due to the following issues. Firstly, it is not exceptional that one scientific paper is written by multiple authors, all of which are affiliated with different institutions based on different continents. Therefore, a clear and robust distinction between the conceptualizations of SFM by different scientific communities is hindered. Secondly, it is questionable if an affiliation represents a sufficient criterion for the analysis of differences in conceptualization of SFM according to the cultural background of a researcher. For example, in recent years it is common for researchers to travel widely and change their affiliations based on the available funding and career opportunities. Hence, one researcher can exchange multiple different affiliations over the analyzed time period. Moreover, one researcher can simultaneously have multiple affiliations and publish his work under different individual affiliations over the same time frame. All of the above suggests that the affiliation alone does not represent a sufficient proxy for a cultural background of a researcher and additional characteristics should be considered. However, such a study is highly complex and it would analyze a research question highly distinct from the ones analyzed in our study. Accordingly, such an effort goes beyond the scope of our work and due to its complexity is worthy of an individual scientific paper. Comparison of our results with the results of studies applying methods more suitable for the investigation of researcher affiliations and collaborations, like social network analysis, is therefore necessary to further elucidate the characteristics of sustainability research in the field of SFM.

Conflicts of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.forpol.2018.02.003.

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